

**MYERS LAKE WATERSHED
FEASIBILITY STUDY**

MARSHALL COUNTY, INDIANA

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Prepared For:

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EXECUTIVE SUMMARY

The Myers Lake Property Owners Association received an Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) grant to complete an engineering feasibility study on lake improvement projects identified during the Myers-Lawrence Lakes Diagnostic Study in 2000. The goal of the feasibility study was to analyze potential project sites where sources of pollution may exist, suggest techniques to reduce the sediment volume entering the lake, and examine the feasibility of project design and construction. To be deemed feasible, project sites need to be physically accessible, the proposed projects need to receive regulatory agency support, be acceptable to property owners, and be environmentally and socially justifiable.

This study pursued the feasibility of two projects within the Myers Lake watershed: channel stabilization and sediment basin construction at the intersection of 12th Road and Pear Road and a settling basin project off the south side of Happy Acres Drive. Since the projects are both fairly small with a combined construction fee of approximately \$13,049 they can be completed as one design-build project using LARE funding or completed separately using a combination of land treatment funds, county road money, or private funding. It is recommended that the Lake Association pursue funding and implementation of these projects while they are still considered feasible to the participants involved.

ACKNOWLEDGEMENTS

This feasibility study was completed with funding from the Indiana Department of Natural Resources Division of Soil Conservation Lake and River Enhancement Program and the Myers Lakes Property Owners Association. J. F. New & Associates, Inc. documented available historical information, assessed project feasibility and environmental impact, and calculated probable opinions of cost for projects in the Myers Lake watershed. Claudia Wayman of the Myers Lakes Property Owners Association provided initiative and assistance in getting this study completed. The Marshall County Department of Geographic Information Systems office provided property owner information for the project areas. Thanks also to the Myers Lakes Property Owners Association members for support. Authors of this report include John Richardson, Marianne Giolitto, and Sara Peel with J.F. New & Associates, Inc. Brian Majka of J.F. New and Associates, Inc. provided GIS maps of the study area.

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1.0 INTRODUCTION

1.1 BACKGROUND

Myers Lake property owners and lake users have recognized that lake water quality is directly connected to activities along the shoreline and in the watershed. Noted lake and lake water quality concerns include: declining dissolved oxygen concentrations in the hypolimnion, increased nutrient levels in the hypolimnion, and an extensive rooted plant community. In 1999, the Myers Association received a grant from the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement (LARE) Program to conduct a lake and watershed diagnostic study in order to document existing conditions in Myers and Lawrence Lakes and their watershed and to diagnose potential pollutant sources to the lake. JFNew conducted the Myers-Lawrence Lake Diagnostic Study in 2000. According to the study, water quality in Myers Lake is good, however, symptoms of eutrophication are present. Phosphorus modeling suggests that the majority of phosphorus loading to Myers Lake originates from internal sources. The study recommended addressing watershed-level issues before attempting in-lake treatment. These watershed-level issues included: sediment and sediment-attached pollutant loading from a farm field along Pine Road south of Myers Lake, stormwater runoff from an agricultural field and erosion of a drainage channel originating from the same field at the corner of Pear Road and West 12th Road. In 2001, Myers Lake Association received a feasibility study grant to follow up on recommendations in the diagnostic study. The purpose of the current study is to determine design and construction feasibility for recommended projects in the Myers Lake watershed.

1.2 SCOPE OF STUDY

The geographical scope of the study encompassed Myers Lake's 858-acre (347.5-ha) watershed in Marshall County. This feasibility study specifically targeted areas identified in the diagnostic study for project implementation. To determine whether a project was feasible JFNew considered whether a project could physically be constructed, whether it was economically and environmentally justifiable, whether it had landowner approval, and whether it had regulatory approval. The following projects (Figure 1) are included in this engineering feasibility study based on survey findings and public input:

1. Sediment control basin and ditch armoring at Pear and West 12th Roads
2. Settling basin construction immediately south of Happy Acres Drive

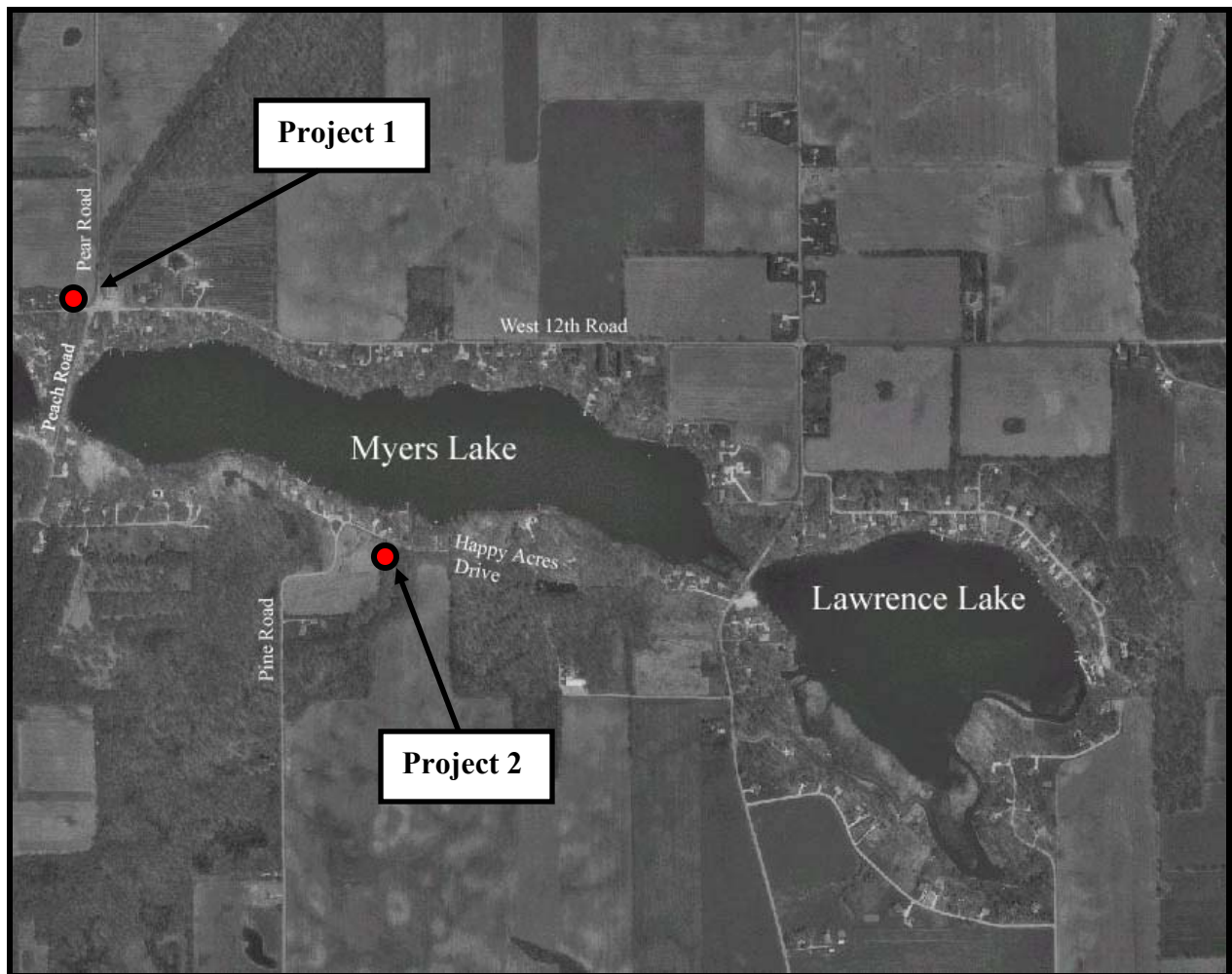


Figure 1. Proposed projects at Myers Lake.

1.3 STUDY GOAL

The goal of this engineering feasibility study is to locate, conceptually design, and foster the development of potential projects that will improve water quality in Myers Lake.

2.0 DESCRIPTION OF STUDY AREA

2.1 LOCATION

The Myers Lake watershed (14-digit hydrologic unit code 0712001060080) encompasses 1.3 square miles (858 acres or 347 hectares) in Marshall County, Indiana (Figure 2). The relatively small watershed is at the upper end of Eagle Creek, a tributary to the Yellow River. Myers Lake has three small inlets: a channel from Lawrence Lake, an intermittent tributary draining the woods and an agricultural field adjacent to Pine Road, and a small intermittent stream on the west end of the lake draining the field adjacent to Pear Road (Figure 3). Water drains west from Myers Lake through a chain of lakes before entering Harry Cool Ditch west of Lake Latonka. Harry Cool Ditch flows west to its confluence with Eagle Creek, a tributary to the Yellow River that in turn flows into the Kankakee River.

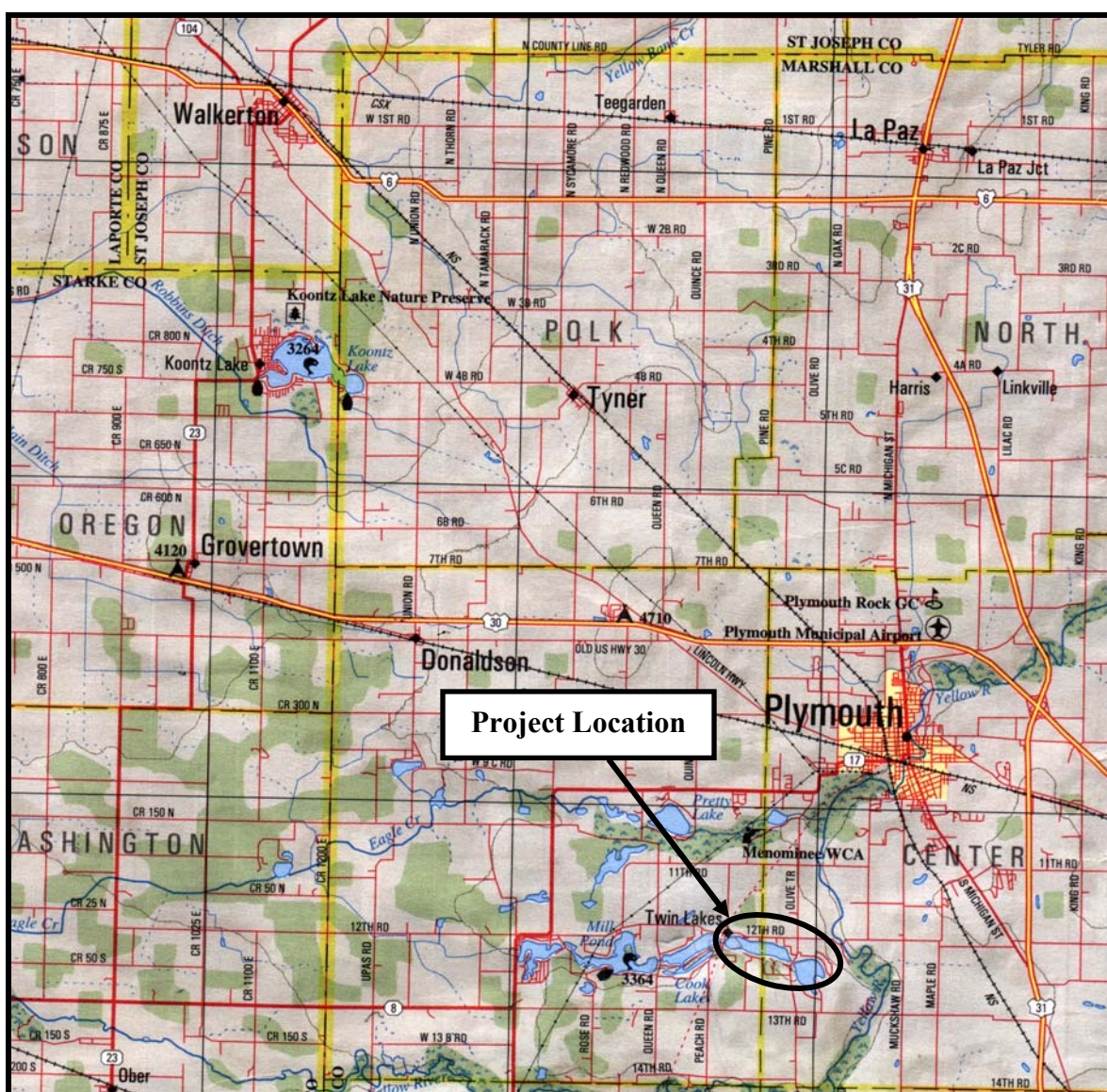


Figure 2. Location of the Myers-Lawrence Lakes watershed.

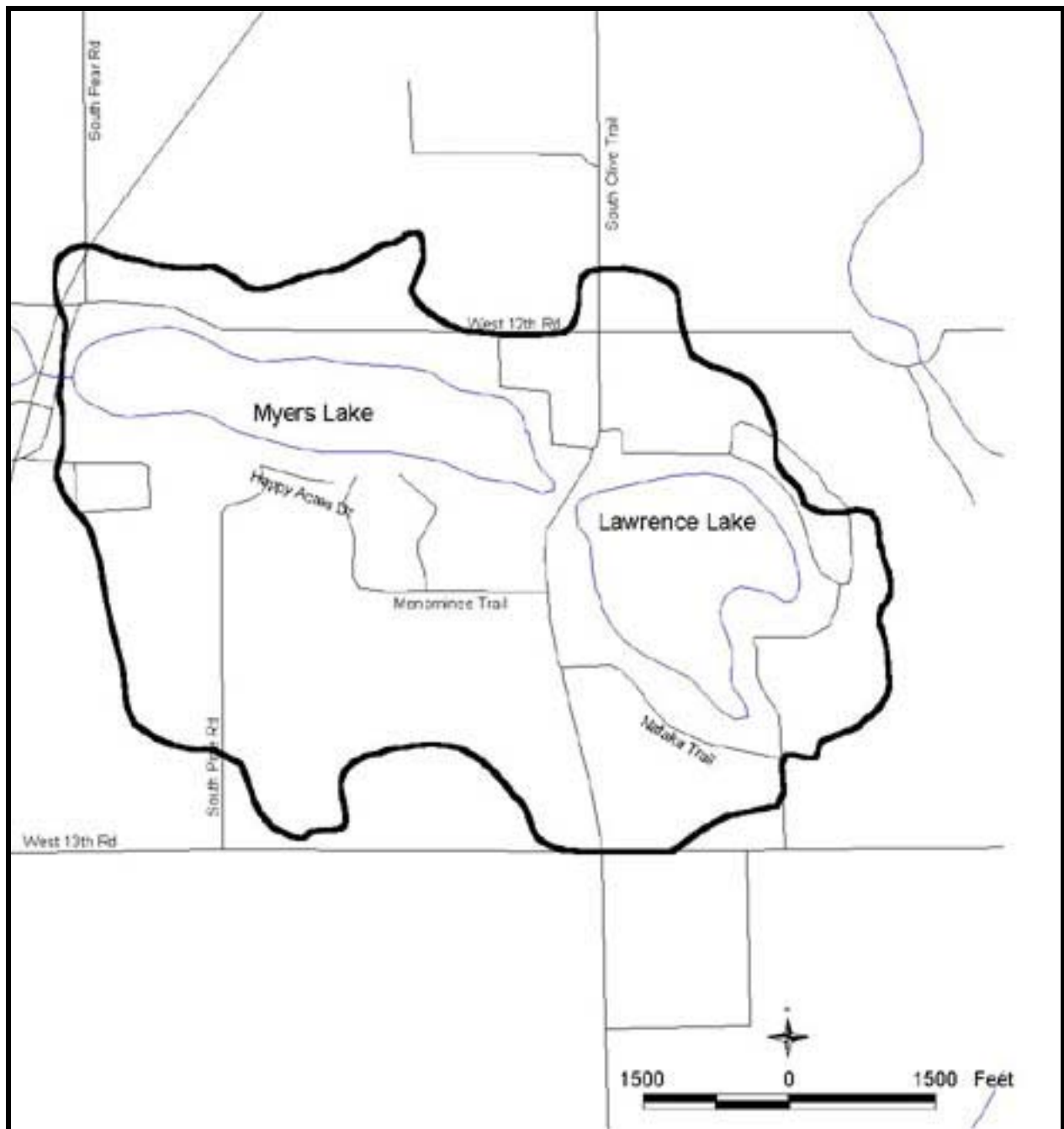


Figure 3. Myers Lake watershed.

2.2 GEOLOGIC HISTORY

The Myers Lake watershed formed during the most recent glacial retreat of the Pleistocene Era. The advance and retreat of the Lake Michigan and Saginaw Lobes of a later Wisconsin age glacier as well as the deposits left by these lobes shaped much of the landscape found in northern Indiana today (Homoya et al., 1985). The Saginaw Lobe retreat left a broad, flat to rolling glaciated plain dotted with wet depression and kettle lakes. Glacial fill and outwash, sandy beach ridges, flat belts of morainal hills, and bog kettle depression are common geological features that characterize the Southern Michigan/Northern Indiana Till Plain ecoregion in which the Myers

Lake watershed lies (Omernik and Gallant, 1988). Many of these geologic features are visible on the Myers Lake watershed landscape today. Myers Lake is a kettle lake that formed when a block of ice trapped in glacial till melted and left behind a water-filled depression.

2.3 LAND USE

The Myers Lake watershed lies within the Northern Lakes Natural Area (Homoya et al., 1985). Natural communities found in this region prior to European settlement included bogs, fens, marshes, prairies, sedge meadows, seep springs, lakes, and deciduous forests. Like much of the landscape in Marshall County, early settlers to the area converted large portions of the natural landscape around Myers Lake to agricultural land uses. Today approximately 58% of the watershed is utilized for agricultural purposes including row crop and pasture (Figure 4). The natural landscape (including second growth forests) remains on a smaller portion of the watershed. Forested land exists on approximately 19% of the watershed. Open water and wetlands cover approximately 18% and 2% of the watershed, respectively. Table 1 provides land use acreages for the Myers Lake watershed based on the USGS/EROS Indiana Land Cover Data Set, Version 98-12.

Table 1. Land use in the Myers Lake watershed.

Land Use	Acres	Hectares	Percentage
Row Crop Agriculture	318.6	128.9	35.8%
Pasture/Hay	200.3	81.1	22.5%
Deciduous Forest	166.9	67.6	18.8%
Open Water	160.4	64.9	18.0%
Low Intensity Residential	18.7	7.6	2.1%
Emergent Herbaceous Wetland	9.9	4.0	1.1%
Woody Wetland	9.1	3.7	1.0%
Evergreen Forest	2.5	1.0	0.3%
High Intensity Residential	2.0	0.8	0.2%
High Intensity Commercial	0.6	0.24	0.1%
Mixed Forest	0.1	0.04	0.01%
Total	889.1	359.96	100.0%

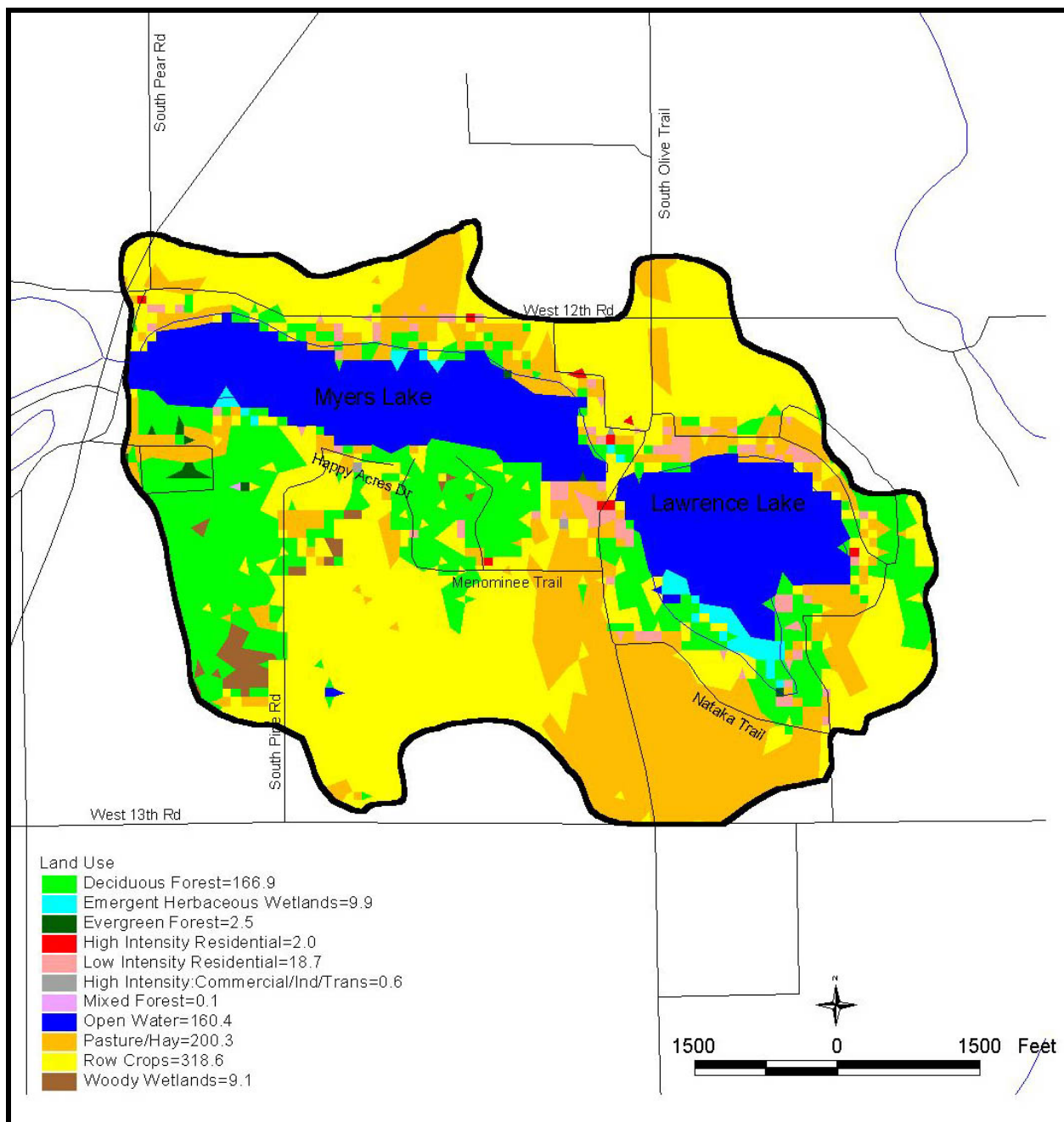


Figure 4. Land use in the Myers Lake watershed.

2.4 SOILS

The soil types found in Marshall County are a product of the original parent materials deposited by the glaciers that covered the area 12,000 to 15,000 years ago. The main parent materials found in Marshall County are glacial outwash and till, lacustrine material, alluvium, and organic materials that were left as the glaciers receded (Smallwood, 1980). The interaction of these parent materials with the physical, chemical, and biological variables found in the area (climate, plant and animal life, time, landscape relief, and the physical and mineralogical composition of the parent material) formed the soils of Marshall County today. Soils that directly border the lakes are of the Riddles-Metea-Wawasee Association, which is primarily composed of gently to

strongly sloped, moderately well to well drained soils that formed in organic material. The Oshtemo-Owosso-Fox Association forms the eastern boundary of the watershed. Soils of this association are gently sloped, well drained soils that formed in glacial outwash. Highly erodible soils cover approximately 28% of the watershed. Both potential projects considered in this feasibility study lie in a highly erodible soil unit.

2.5 EXISTING AND PLANNED BEST MANAGEMENT PRACTICES

Other best management practices have not been identified in the Myers Lake watershed. The projects suggested in this study represent the first Best Management Practice (BMP) implementation plan sponsored by the Myers Lake Association.

2.6 PRIOR STUDIES

Table 2 documents prior studies conducted at Myers and Lawrence Lakes. Most studies conducted in the area have been focused on documenting existing water quality or fishery conditions within the lake. The 2000 diagnostic study was the first study to address management of the areas draining into Myers and Lawrence Lakes.

Table 2. Prior studies conducted in the Myers Lake Watershed.

Year	Entity	Topic	Study
1954	IDNR, DOW	Bathymetry	Bathymetric map of Myers Lake
1958	IDNR, DOW	Bathymetry	Bathymetric map of Lawrence Lake
1968	IDNR, DFW	Fisheries	Fish Management Report Myers Lake
1968	IDNR, DFW	Fisheries	Lawrence Lake Fish Survey Report
1977	IDNR, DFW	Fisheries	Myers Lake Fish Management Report
1977	IDNR, DFW	Fisheries	Lawrence Lake Fish Management Report
1986	IDEM	Water Quality	In Lake Classification System and Management Plan
1986	IDNR, DFW	Fisheries	Lawrence Lake Fish Management Report
1986	IDNR, DFW	Fisheries	Myers Lake Fish Management Report
1989	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
1990-1993	IDEM, CLP, VMP	Water Quality	Volunteer Water Quality Monitoring
1995	IDEM, CLP	Water Quality	Indiana Clean Lakes Assessment
1998	IDNR, DFW	Fisheries	Lawrence Lake Cisco Survey
2000	IDNR, DSC/JFNew	Lake and Watershed Management	Myers-Lawrence Lakes Diagnostic Study
2002	IDNR, DSC/JFNew	Watershed Management	Myers Lake Feasibility Study

IDNR=Indiana Department of Natural Resources
DFW=Division of Fish and Wildlife
DOW=Division of Water
IDEM=Indiana Department of Environmental Management
CLP=Clean Lakes Program
DSC=Division of Soil Conservation
JFNew=J.F. New & Associates, Inc.

3.0 RECOMMENDED PROJECTS/FEASIBILITY ANALYSIS

3.1 SEDIMENT BASIN CONSTRUCTION AND DITCH ARMORING AT WEST 12TH AND PEAR ROADS

3.1.1 Site Description and Alternatives

The West 12th and Pear Roads sediment basin construction and ditch armoring project (12th and Pear Project) is located at the intersection of West 12th and Pear Roads (Figure 1). The project site consists of three main areas: 1) the drainage inlet area immediately north of West 12th Road and 100 feet west of Pear Road; 2) the drainage ditch that runs parallel to Peach Road south of West 12th Road; and 3) the outlet of the drainage ditch into Myers Lake on the east side of Peach Road (Figure 5). The proposed project includes 475 lineal feet of this unnamed intermittent drainage. (Appendix A contains site photographs from the West 12th and Pear Road project site.)



Figure 5. Aerial photograph of drainage involved in the sediment basin construction and ditch armoring project.

Row crop agriculture, a second growth woodlot, and Pear Road border the unnamed drainage. The drainage begins as overland sheet flow from an agricultural field, is intercepted on the north side of West 12th road by a 12-inch diameter standpipe, crosses under West 12th Road in a 6-inch drain tile and empties into an open drainage ditch approximately 40 feet west of Peach Road. The open channel then flows along Peach Road as a roadside ditch before crossing Peach Road and emptying into Myers Lake approximately 400 feet south of West 12th Road. Sediment enters the drainage system from the agricultural field and the eroding banks of the drainage ditch.

The alternatives considered to treat water quality issues at the West 12th and Pear Road site include:

1. Constructing a sediment basin and filter strip at the northwest corner of the intersection.
2. Hard armoring the length of the drainage ditch along Peach Road.
3. Constructing the sediment basin and armoring the length of the drainage ditch.
4. No action.

Alternative 1 involves constructing a sediment basin immediately northwest of the intersection of West 12th and Pear Roads. Constructing the sediment basin would retain runoff during storm events allowing sediment particles to settle. Additional erosion control can be gained with the suggested grass filter strip in front of the sediment basin. The grass filter will filter sediment from the overland flow before it reaches the sediment basin. The proposed infiltration trenches in the sediment basin will allow the water to drain slowly from the basin reducing the velocity of water in the drainage ditch downstream. Constructing a well-engineered sediment basin would cost an estimated \$6,138 (Appendix B contains detailed cost estimates for the considered alternatives.) Alternative 1 does not address all of the identified erosion problems with this drainage. Alternative 2 involves hard armoring 460 lineal feet of the drainage ditch. Hard armoring the ditch would curtail streambank and bed erosion, but does not address the sediment and sediment-attached pollutant loading from the agricultural field. Armoring the length of the drainage would cost approximately \$4,632. Alternative 3 combines Alternatives 1, constructing a sediment basin northwest of the intersection, and Alternative 2, stabilizing the drainage ditch using hard armoring techniques, to correct all of the identified sediment sources identified at this site. The sediment basin would regulate the flow of water entering the drainage pipe northwest of the West 12th and Pear Road intersection which will reduce sediment and sediment-attached pollutant loading to the drainage ditch. Hard armoring the length of the drainage will curtail bed and bank erosion along the ditch. Although Alternative 3 is the most costly at approximately \$11,553, it addresses all of the identified water quality issues. Alternative 4 is also feasible; however, sediment loading from this drainage is not expected to decrease over time unless the agricultural field is turned into grassland. To address the majority of sediment sources from this drainage, Alternative 3 is the best alternative for treating the observed problems at this location.

3.1.2 Preliminary Design

Sediment basin construction at this site will consist of the construction of a levee immediately north of the current drainage standpipe (Figure 6). The drainage area for the sediment basin is approximately 20 acres. The levee will be approximately 90 feet long, have a base width of 20 feet and a maximum height of 3 feet. Gravel infiltration trenches are conceptually designed to pick up water backed up by the levee and will connect to the existing standpipe on the backside of the levee. A grass channel spillway is proposed adjacent to the levee to guide excess water into the existing standpipe. The infiltration trenches should contain septic stone surrounding 4-6 inch perforated drainage tile in a 2 x 2 foot trench. The tiles are connected directly with the existing standpipe drain. The area containing the tiles shall be planted with native grasses to achieve 100 percent ground cover for approximately 30-50 feet upslope of the levee. Figure 7 illustrates the preliminary design of the constructed levee.

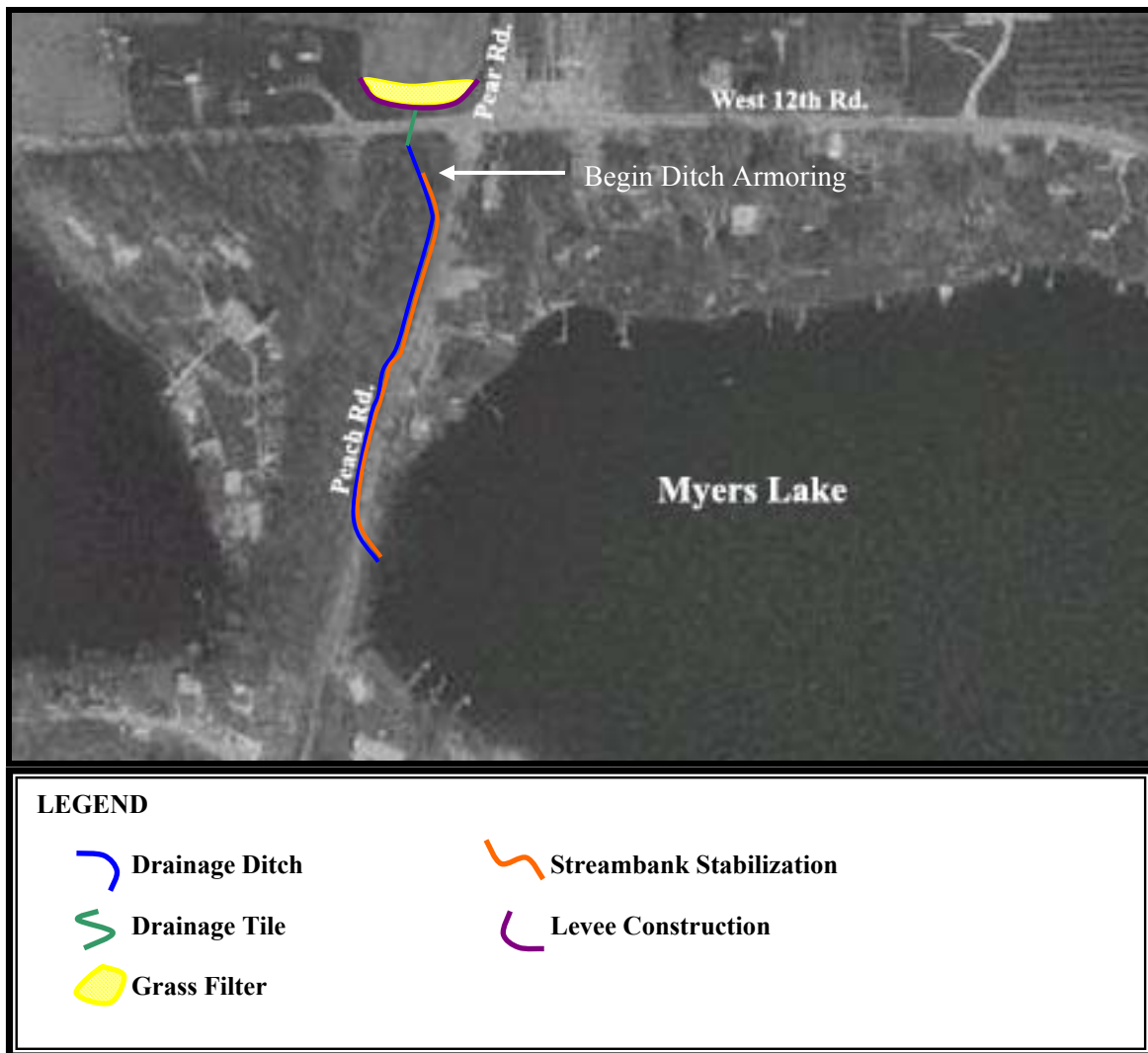


Figure 6. Preliminary plan view of sediment basin construction and stream hard armoring at West 12th and Pear Roads.

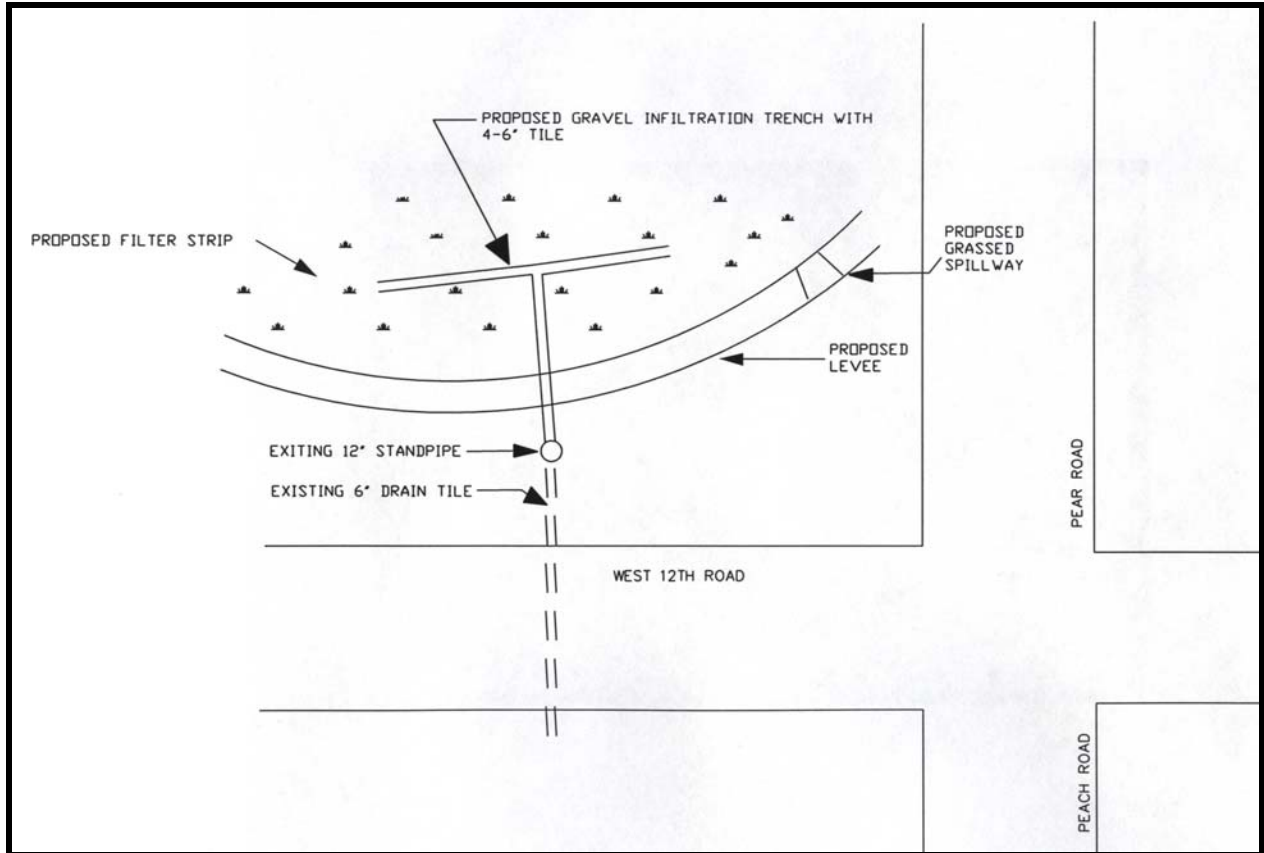


Figure 7. Conceptual design for sediment basin construction.

Streambank stabilization will include the installation of hard armor along the length of the channel (Figure 6). Hard armoring the channel will consist of the placement of glacial stone 3-6 inches in diameter to a thickness of up to one foot along the entire channel (Figure 8). The drainage outlet will be stabilized with slightly larger diameter stone to prevent wave energy from eroding away the rock.

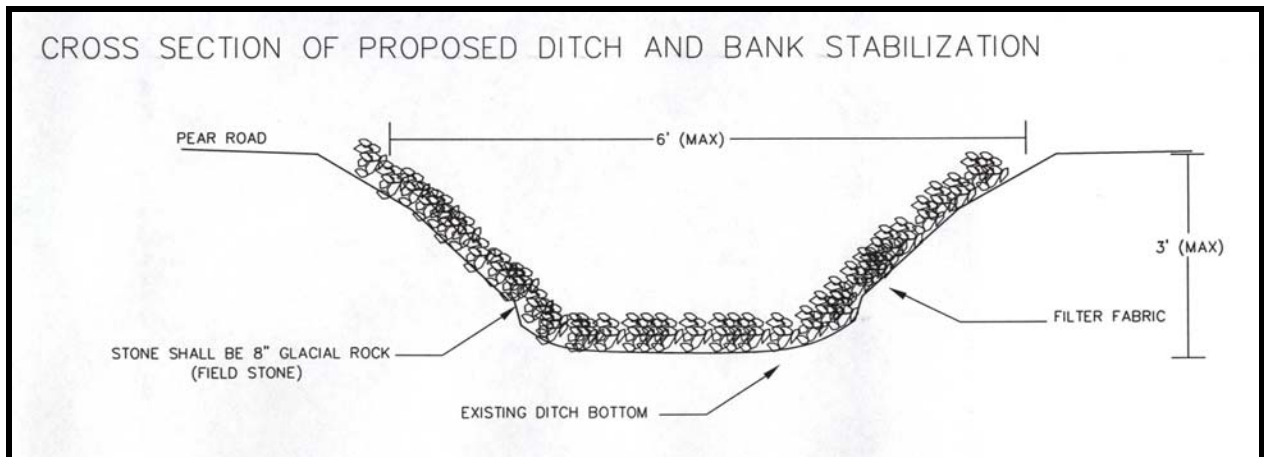


Figure 8. Conceptual design for stream hard armoring.

3.1.3 Permit Requirements

The proposed project will require permission from the Marshall County Highway Engineer since a majority of the project is within the county right-of-way. Permits are not required from IDEM, IDNR, the U.S. Army Corps of Engineers (Corps), or the Marshall County Drainage Board.

3.1.4 Landowner Agreements

There are three landowners who own land affected by the proposed project area. During preliminary meetings the landowners of the agricultural field indicated their support of the conceptual project. Landowners affected by the ditch armoring west of Peach Road and adjacent to Myers Lake have been contacted with preliminary designs. The only concern expressed in writing was that of utilities crossing under the ditch. Letters acknowledging landowner support are included in Appendix C.

3.1.5 Unusual Physical and Social Costs

Unusual physical and social costs associated with the construction of the project include: avoiding landowner septic systems, attaining access to ditch banks without damaging the riparian corridor, and storing construction materials and equipment during construction. One landowner's septic system is pumped from a home adjacent to Myers Lake underneath the ditch and the road to a tank located on the west side of Peach Road. The septic lines should be marked prior to project initiation in order to avoid any potential damage that may occur during project construction. A majority of the project lies adjacent to either West 12th or Peach Road and is within the County right-of-way. However, a portion of the ditch does lie within private property in a second growth woodlot. This portion of the project could be completed with smaller machinery to minimize impacts to the riparian woodlot. If this is not possible, access will be attained from the northern property boundary at a location where impact to the riparian area due to tree removal, soil compaction, or erosion would be minimal. Additionally, the storage of materials including earth, fabric, rocks, and vehicles will temporarily degrade the property's aesthetic value. Construction costs should include maintenance and repair of temporary access and storage areas as well as erosion control methods utilized during construction.

3.1.6 Environmental Impact Assessment

Sediment basin construction and ditch armoring will have minimal environmental impacts on the project site. Since wetlands do not exist within the project limits, no impacts to wetlands or their flora or fauna are anticipated. Although an endangered species survey was not conducted, the documented plants at the West 12th and Peach Road project site did not include any state-listed species. Additionally, the DNR Division of Nature Preserves database does not document any endangered, threatened, or rare plant species in the Myers Lake watershed. Sediment basin construction and ditch hard armoring should lead to improved water quality in the ditch and Myers Lake as erosion and sediment and sediment-attached pollutant loading is reduced. The biotic integrity of the ditch was not assessed as part of this project. During the majority of site visits the ditch did not contain any water. It is likely that macroinvertebrates inhabit the ditch during the spring; however it is unlikely that fish utilize any portion of the ditch. Over the long-term hard armoring will provide additional in-stream habitat for the macroinvertebrate community. Any impacts from project construction on the macroinvertebrate community should be minimal and temporary.

3.1.7 Probable Cost Estimate

Sediment basin construction and ditch hard armoring is estimated to cost approximately \$9,000 including materials and installation costs (Table 3).

Table 3. Sediment basin construction and ditch hard armoring probable cost estimate.

Item	Cost	Unit	Quantity	Total
Sediment Basin Construction				
Levee construction	\$6	Cubic yard	270	\$1,602
Seeding	\$500	Acre	0.1	\$500
Blanketing	\$2	Square yard	250	\$500
Infiltration Trench				
Excavation	\$6	Cubic yard	3.3	\$414
Gravel	\$15	Ton	5.25	\$79
Drainage tile	\$3.50	Foot	90	\$315
Stream Stabilization				
Rock	\$25	Ton	160	\$4,000
Blanketing	\$2	Square yard	316	\$632
Construction Contingency	25%	Construction costs		\$2,010
Mobilization/Demobilization		Lump sum		\$1,497
TOTAL				\$11,549

3.2 SETTLING BASIN CONSTRUCTION SOUTH OF HAPPY ACRES DRIVE

3.2.1 Site Description and Alternatives

The proposed project is located in an intermittent stream that flows north from a second growth woodlot in the southern portion of the watershed, picks up drainage from an agricultural field, then meanders through a wooded ravine before discharging into Myers Lake through a culvert under Happy Acres Drive (Figure 1). Immediately south of Happy Acres Drive the channel flows through a broad valley bounded on the east and west by 15-foot high banks and to the north by a 7-foot high bank supporting Happy Acres Drive. (Appendix A contains site photographs from the Happy Acres Drive project site.) Musclemwood, hickory, garlic mustard, and wood reed-grass dominate the valley floor. Cottonwood, American elm, green ash, buttonbush, false nettle, elderberry, and jewelweed dominate the riparian area in the northern portion of the ravine. This stream is the largest inlet and delivers a heavy load of sediment and associated nutrients during certain storm events to Myers Lake (JFNew, 2000). A proposed settling basin immediately south of Happy Acres Drive addresses this sediment load (Figure 9).

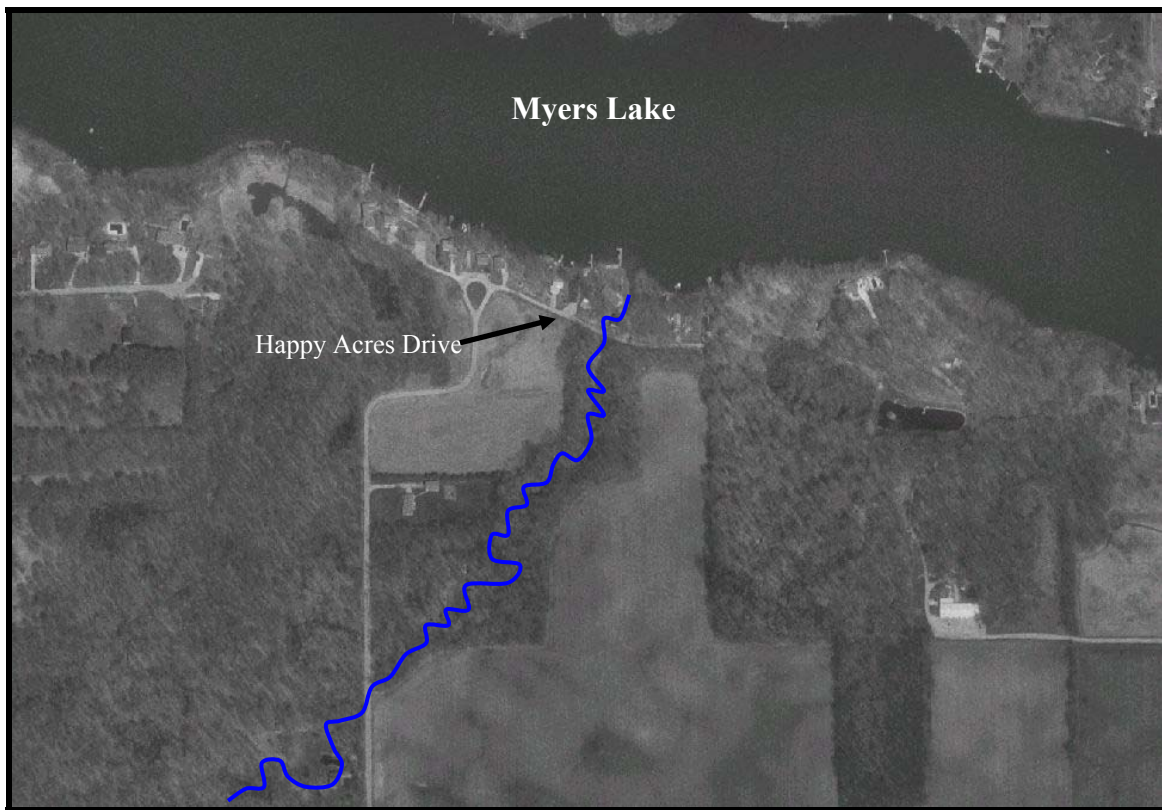


Figure 9. Aerial photograph of the drainage involved in the settling basin project.

Observations made during the diagnostic study indicate that during some storm events water from this channel does not reach Myers Lake. However, water flows through this channel following periods of prolonged or intense precipitation. During some storm events water moves through the channel scouring the streambed and delivering heavy sediment loads to Myers Lake. Although these severe storm events may not occur regularly, they do increase sediment and sediment-attached pollutant loading to Myers Lake.

Reducing the sediment delivery to Myers Lake from this drainage system can be most easily accomplished by allowing the existing valley to store water during extreme precipitation events and release it slowly to Myers Lake. Water velocities decrease in a storage basin allowing sediment and sediment-attached pollutants to settle out of the water column.

The alternatives considered to treat water quality issues at the Happy Acres Drive site include:

1. Creating a settling basin by installing a standpipe on the Happy Acres Drive culvert.
2. Creating a large sediment trap.
3. No action.

Alternative 1 involves modifying the 30-inch culvert that passes under Happy Acres Drive to Myers Lake. Attaching a perforated standpipe to the open culvert would cause water to pond south of Happy Acres Drive creating a settling basin. Although this alternative could cause flooding within the valley, flows are not high enough to impact agricultural fields upstream or structures adjacent to the valley. Alternative 1 would cost approximately \$1,500 for the structure and installation. Alternative 2 is also a feasible option; however, the cost of a sediment trap would range from \$6-12,000 depending on the size of the basin. Alternative 3 is feasible, however, the sediment loading to Myers Lake will continue indefinitely from this channel. These considerations indicate that Alternative 1 is the best alternative for treating the observed problems at this location.

3.2.2 Preliminary Design

Settling basin construction in this reach will consist of the installation of a perforated standpipe on the south side of the Happy Acres Drive culvert (Figure 10). The standpipe will be sized to allow water to freely enter at a predetermined level with restricted flow perforations to the level of the valley floor. The perforations will be designed to allow for a minimum of 24-hour detention on a 2, 10, and 50 year storm event (Figure 11). Sediment and sediment-attached pollutants will be deposited within the floodplain. The settling basin will decrease the velocity and sediment load of the water entering Myers Lake.

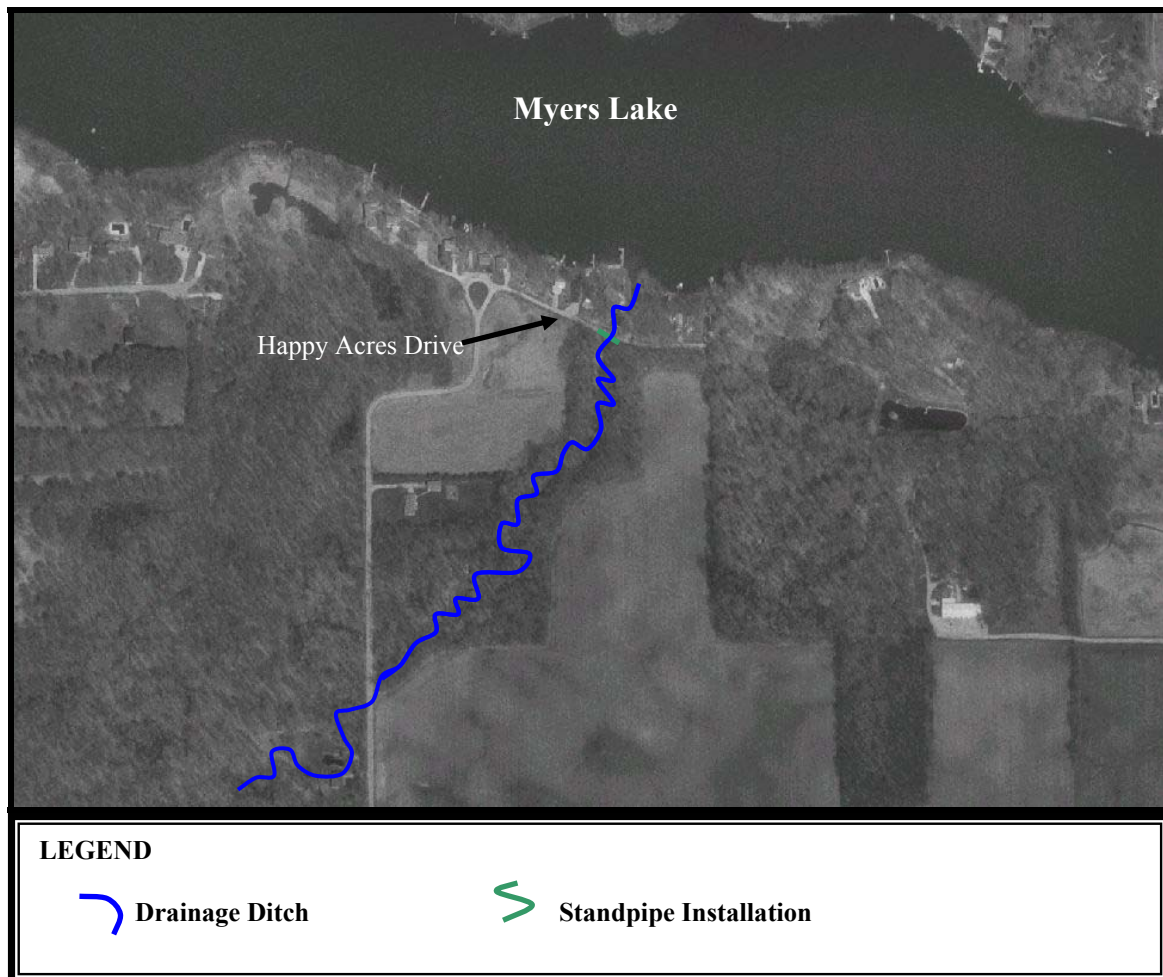


Figure 10. Preliminary plan view of settling basin construction immediately south of Happy Acres Drive.

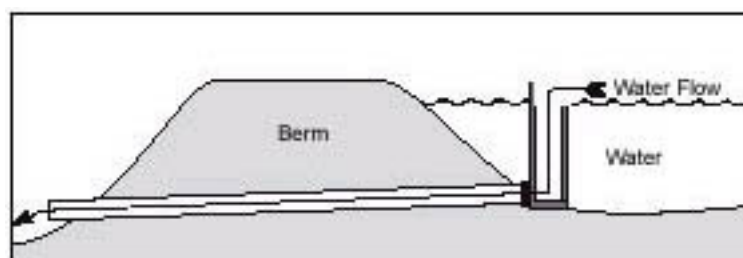


Figure 11. Conceptual design for settling basin construction.

3.2.3 Permit Requirements

The proposed project requires permission from the Marshall County Engineer since the project affects the road. Permits are not required from IDEM, IDNR, the U.S. Army Corps of Engineers (Corps), or the Marshall County Drainage Board. The County Engineer's comments regarding this proposed project are included in Appendix C.

3.2.4 Landowner Agreements

There are two landowners who own land affected by the proposed project area. During preliminary meetings the both landowners indicated their support of the conceptual project. Letters supporting these preliminary plans are included in Appendix C.

3.2.5 Unusual Physical and Social Costs

Unusual physical and social costs associated with the project include: avoiding wetland areas during standpipe installation and maintaining the stability of the embankment supporting Happy Acres Drive. The valley upstream of Happy Acres Drive is considered a wetland. Attaching a standpipe to create a settling basin will increase the frequency and period of inundation of the floodplain. Construction activities will consist of laborers attaching a standpipe to the existing culvert. No heavy machinery is required for this project. The stability of the embankment created with the construction of Happy Acres Drive will not be affected by the creation of a settling basin. Soil borings indicate that existing embankment fill consisting of clay, organic material, and granular soils will maintain their structural integrity if head levels within the settling basin remain at low levels (Appendix D). The height of the water control structure inlet and sizing of the perforations can be determined during design to ensure the safety of the road.

3.2.6 Environmental Impact Assessment

Settling basin construction will have minimal impacts on adjacent wetland areas. Wetlands located within the confines of the settling basin may be inundated with greater frequency and duration. Up to five cottonwood and/or American elm trees could be impacted by the increased inundation. Although an endangered species survey was not conducted, the plant species documented at the Happy Acres Drive project site did not include any state-listed species. Additionally, the DNR Division of Nature Preserves database does not document any endangered, threatened, or rare (ETR) plant species in the Myers Lake watershed. Because water flow in the affected valley is intermittent, it is unlikely that any fish or permanent macro-invertebrates exist in the stream. Therefore, biotic integrity of the channel was not assessed as part of this project. Additionally, the DNR Division of Nature Preserves database does not document any ETR fish species within the Myers Lake watershed.

3.2.7 Probable Cost Estimate

Settling basin construction at this project site is estimated to cost approximately \$1,500 including structure purchase and installation (Table 4).

Table 4. Settling basin construction probable cost estimate.

Item	Cost	Unit	Quantity	Total
Settling Basin Construction				
Standpipe	\$700	Lump sum	1	\$700
Installation	\$500	Lump sum	1	\$500
Construction Contingency	25%	Construction costs		\$300
TOTAL				\$1,500

4.0 SUMMARY OF COST ESTIMATES AND FUNDING

Two projects have been recommended to improve water quality within the Myers Lake watershed. Table 5 lists cost estimates for each of the recommended restoration projects.

Table 5. Summary of project budgets.

Project	Report Section	Construction	Contingency	Total
Sediment basin construction and stream stabilization at West 12th and Pear Roads	3.1	\$9,539	\$2,010	\$11,549
Settling basin construction immediately south of Happy Acres Drive	3.2	\$1,200	\$300	\$1,500
TOTAL		\$10,739	\$2,310	\$13,049

5.0 RECOMMENDATIONS

1. Pursue funding to implement the settling basin construction project immediately south of Happy Acres Trail. Funding could be private or from SWCD land treatment funds.
2. Pursue funding for the sediment basin construction and stream stabilization at the intersection of West 12th and Pear Roads. Funding could be private, SWCD land treatment funds, LARE design-construction funds, or 319 funds.
3. Establish a dialog with the Soil and Water Conservation District (SWCD) office and the landowners of various parcels where BMPs were recommended during the diagnostic study. A long-term, trusting relationship with these landowners may result in conservation and/or restoration project implementation.
4. Once external nutrient loading has been reduced, re-evaluate Myers Lake chemistry and conditions to determine if in-lake treatments should be pursued.
5. Pursue acquisition of feasibility study funding to address various other recommendations included in the Myers-Lawrence Lakes Diagnostic Study.

6.0 LITERATURE CITED

- Homoya, M.A., B.D. Abrell, J.R. Aldrich, and T.W. Post. 1985. The natural regions of Indiana. Indiana Academy of Science. Vol. 94. Indiana Natural Heritage Program. Indiana Department of Natural Resources, Indianapolis, Indiana.
- J.F. New & Associates, Inc. 1999. Myers-Lawrence Lakes Diagnostic Study. Indiana Department of Natural Resources. Lake and River Enhancement Program. Indianapolis, Indiana.
- Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the upper Midwest states. USEPA, ERL. Corvallis, Oregon. EPA/600/3-88/037.
- Smallwood, B.F. 1980. Soil Survey of Marshall County, Indiana. USDA Soil Conservation Service and Purdue Agricultural Experiment Station.

APPENDIX A
SITE PHOTOGRAPHS

**MYERS LAKE WATERSHED
FEASIBILITY STUDY**

MARSHALL COUNTY, INDIANA



Intersection of West 12th and Pear Roads.



Current stand pipe and drain northwest of the intersection of West 12th and Pear Roads.



Beginning of surface drain. The drain pipe is connected to the standpipe underneath West 12th Road.



Riparian woodlot south of the intersection of West 12th and Pear Roads.



Surface drain running parallel to Pear Road prior to entering Myers Lake.



Surface drainage east of Pear Road prior to entering Myers Lake.



View of drain pipe from Happy Acres Drive.



Opening of drain pipe which passes underneath Happy Acres Drive.



Riparian area in the valley immediately south of Happy Acres Drive.



View of immediate area where the modification will occur immediately south of Happy Acres Drive.

APPENDIX B

**DETAILED COST ESTIMATES FOR
CONSIDERED ALTERNATIVES**

**MYERS LAKE WATERSHED
FEASIBILITY STUDY**

MARSHALL COUNTY, INDIANA

Cost Estimates for Alternative Treatments Identified for the West 12th and Pear Roads Site

Alternative 1: Constructing a sediment basin

Cost

Levee Construction

Dimension of levee:

Length of levee: 90 feet

Base width of levee: 20 feet

Average height: 4 feet

Total volume of clay required: 267 cubic yards

Cost of clay (including construction): \$6/cubic yard

Total Cost \$1,602

Blanketing

Length to be blanketed: 90 feet

Width to be blanketed: 25 feet

Total area to be blanketed: 250 square yards

Cost of fabric: \$2/square yard

Total Cost \$500

Seeding

Length to be seeded: 100 feet

Width to be seeded: 60 feet

Total area to be seeded: 6,000 square feet of 0.13 acres

Cost of seeding: \$500/acre

Total Cost \$500

Infiltration Trench Construction

Length to be excavated: 90 feet

Width to be excavated: 1 foot

Depth to be excavated: 1 foot

Total area of excavation: 3.3 cubic yards

Cost of excavation: \$6/cubic yards

Total volume of gravel required: 5.25 tons

Cost of gravel: \$15/ton

Total length of tile required: 90 feet

Cost of 4" or 6" tile: \$3.50/foot

Total Cost \$808

Mobilization/demobilization \$1,500

Construction Contingency

Assume a contingency of 25% \$1,228

TOTAL COST **\$6,138**

Alternative 2: Hard armoring the length of the drainage ditch

Cost

Length of reach: 375 lineal feet

Hard armoring

Length of stone required: 475 lineal feet

Width of stone required: 6 feet

Total amount of stone required: 105 cubic yards

Cost of stone: \$25/ton

Total Cost

\$4,000

Blanketing

Length to be blanketed: 475 feet

Width to be blanketed: 6 feet

Total area to be blanketed: 315 square yards

Cost of fabric: \$2/square yard

Total Cost

\$632

TOTAL COST

\$4,632

Alternative 3: Constructing the sediment basin and stabilizing the length of the drainage ditch using hard armor

Cost

Levee Construction

Dimension of levee:

Length of levee: 90 feet

Base width of levee: 20 feet

Average height: 4 feet

Total volume of clay required: 267 cubic yards

Cost of clay (including construction): \$6/cubic yard

Total Cost \$1,602

Blanketing

Length to be blanketed: 90 feet

Width to be blanketed: 25 feet

Total area to be blanketed: 250 square yards

Cost of fabric: \$2/square yard

Total Cost \$500

Seeding

Length to be seeded: 100 feet

Width to be seeded: 60 feet

Total area to be seeded: 6,000 square feet of 0.13 acres

Cost of seeding: \$500/acre

Total Cost \$500

Infiltration Trench Construction

Length to be excavated: 90 feet

Width to be excavated: 1 foot

Depth to be excavated: 1 foot

Total area of excavation: 3.3 cubic yards

Cost of excavation: \$6/cubic yards

Total volume of gravel required: 5.25 tons

Cost of gravel: \$15/ton

Total length of tile required: 90 feet

Cost of 4" or 6" tile: \$3.50/foot

Total Cost \$808

Hard armoring

Length of stone required: 475 lineal feet

Width of stone required: 6 feet

Total amount of stone required: 105 cubic yards

Cost of stone: \$25/ton

Total Cost \$4,000

Blanketing

Length to be blanketed: 475 feet

Width to be blanketed: 6 feet

Total area to be blanketed: 315 square yards

Cost of fabric: \$2/square yard

Total Cost \$632

Construction Contingency

Assume a contingency of 25% \$2,011

Mobilization/demobilization \$1,500

TOTAL COST **\$11,553**

APPENDIX C

**COMMUNICATION WITH AGENCIES AND
PROPERTY OWNERS**

**MYERS LAKE WATERSHED
FEASIBILITY STUDY**

MARSHALL COUNTY, INDIANA

Communication with Agencies and Property Owners

Regional and state agencies and property owners were consulted throughout the process of completing this Feasibility Study. Communication from these individuals is not included in this file, but is available from the Indiana Department of Natural Resources Lake and River Enhancement Program Office or from JFNew.

APPENDIX D

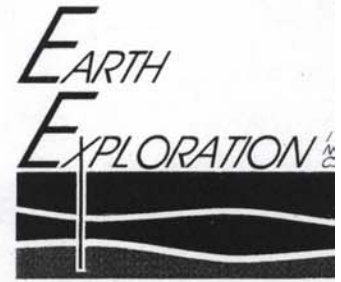
**PRELIMINARY GEOTECHNICAL
EVALUATION**

**MYERS LAKE WATERSHED
FEASIBILITY STUDY**

MARSHALL COUNTY, INDIANA

June 17, 2002

Mr. Jason E. Tidwell
J. F. New & Associates, Inc.
6640 Parkdale Place, Suite S
Indianapolis, IN 46254



► 7770 West New York Street
Indianapolis, IN 46214-2988
317-273-1690 (FAX) 317-273-2255
4310-C Technology Drive
South Bend, IN 46628
574-233-6820 (FAX) 574-233-8242

Re: Preliminary Geotechnical Evaluation
Proposed Earthen Levee for
Myers Lake Property Association
Plymouth, Indiana
EEI Project No. 1-02-096

Dear Jason:

As requested, we have completed our preliminary evaluation for the referenced project. For your information, this letter presents our findings from the exploratory field program and discusses the feasibility of utilizing a portion if not all of the existing embankment as an earthen levee. Furthermore, we understand that J.F. New & Associates, Inc. (JFN) is preparing an engineering feasibility report as part of a LARE funded project sponsored by the Myers Lake Property Association. In part, this report addresses various alternatives for managing watershed through an existing ravine. One alternative being considered is the construction of an earthen levee that would retain surface water flows on a temporary basis without creating large amounts of suspended sediments downstream. As you are aware, the concepts are at an early stage, and consequently, our findings should be regarded as preliminary in nature. Depending on the actual approach, it may be necessary to gather additional information and/or provide further recommendations for design and construction of the levee.

As discussed, Earth Exploration, Inc. (EEI) performed two test borings at the site to determine what soil and groundwater conditions were present. These borings were located along the south shoulder of an existing roadway embankment for Happy Acres Drive. Furthermore, elevations at the test borings were obtained via referencing the top of a manhole structure immediately north of the drive (i.e., assumed benchmark: Elevation 100).

Based on the observations at the test boring locations, the soil conditions typically consisted of (in descending order): lean clay (existing embankment fill); organic clay; and granular soils including silt and sand in various amounts. Furthermore, groundwater was observed near Elevation 91, and the water level of Myers Lake was observed to be about Elevation 93.

Based on a cursory review of the field data and the results of limited laboratory testing, the concept of utilizing the existing embankment for an earthen levee is feasible. However, depending on retention times for various head levels within the impoundment, underseepage of the embankment could create concerns regarding stability. This is considering the presence of granular soils and already somewhat loose nature. Furthermore, it is plausible that the layer of organic clay could loose resistance to shear given the elevated groundwater levels. For this alternative to be viable, consideration may have to be given to installing a relatively shallow cut-off

June 17, 2002

Page 2

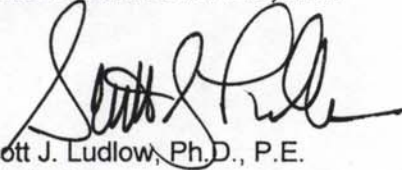
Mr. Jason E. Tidwell
J.F. New & Associates, Inc.

wall consisting of steel or vinyl sheet piling. Depending on head levels, the tip of the sheeting may be required to be established near a depth of 20 ft below the existing ground surface. Furthermore, the idea of raising the crest of the existing embankment is also plausible provided a stable slope of say three horizontal to one vertical can be constructed without encroaching right of way or other site constraints (i.e., an existing garage that is located north of the embankment.) However, this will not do anything to reduce the underseepage.

Given the preliminary nature of the concepts, hopefully, the discussion presented herein is sufficient for your present needs. Once the concepts become more definitive, it may be necessary to gather additional information and/or provide further recommendations for design and construction of the levee. Additionally, if you should have any other questions regarding the feasibility of this alternative, please contact our office.

Sincerely,

EARTH EXPLORATION, INC.



Scott J. Ludlow, Ph.D., P.E.
Principal

Attachments: Unified Soil Classification System/General Notes
 Log of Test Boring (2)



UNIFIED SOIL CLASSIFICATION SYSTEM / GENERAL NOTES

FINE-GRAINED SOILS		COARSE-GRAINED SOILS		RELATIVE PROPORTIONS		ORGANIC CONTENT BY COMBUSTION METHOD	
CONSISTENCY	UNCONFINED STRENGTH (tsf)	RELATIVE DENSITY	N-VALUE* (Blows/ft)	TERM	DEFINING RANGE BY % OF WEIGHT	SOIL DESCRIPTION	LOI
Very Soft	<0.25	Very Loose	0 - 4	Trace	0 - 5	Trace Organic Matter	0 - 5%
Soft	0.25 - 0.5	Loose	4 - 10	Little	5 - 12	Little Organic Matter	5 - 12%
Medium	0.5 - 1.0	Medium Dense	10 - 30	Some	12 - 35	Organic Silt/Clay	12 - 35%
Stiff	1.0 - 2.0	Dense	30 - 50	And	35 - 50	Sedimentary Peat	35 - 50%
Very Stiff	2.0 - 4.0	Very Dense	50+			Fibrous and Woody Peat	50%±
Hard	>4.0						

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART					
MAJOR DIVISIONS			SYMBOLS & DESCRIPTIONS		
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		Little or no fines	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	
	SAND AND SANDY SOILS	CLEAN SANDS	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		Little or no fines	SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES	
			Appreciable amount of fines	SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SAND OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT	
NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS					

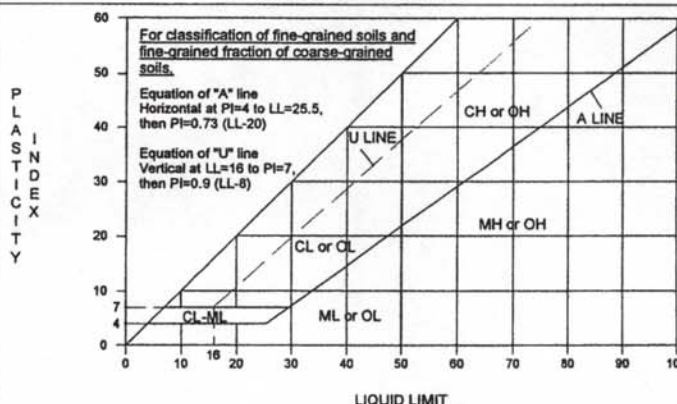
NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

GRAIN SIZE TERMINOLOGY

SOIL FRACTION	PARTICLE SIZE	US STANDARD SIEVE SIZE
Boulders	Larger than 12-in.	Larger than 12-in
Cobbles	3 to 12-in.	3 to 12-in
Gravel	Coarse	3/4 to 3-in
	Fine	#4 to 3/4-in
Sand	Coarse	2.00 to 4.75 mm
	Med	0.425 to 2.00 mm
	Fine	0.075 to 0.425 mm
Silt	0.005 to 0.075 mm	Smaller than #20
Clay	Smaller than 0.005 mm	Smaller than #20

Plasticity characteristics differentiate between silt and clay.

PLASTICITY CHART



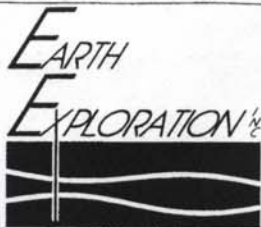
EXPLORATORY SAMPLING ABBREVIATIONS

AS - Auger Sample	PID - Photo-Ionization Detector
BF - Backfilled Upon Completion	PMT - Borehole Pressuremeter Test
BS - Bag Sample	PT - 3-in. O.D. Piston Sample
C - Casing: Size 2½-in., NW; 4-in., HW	PTS - Peat Sample
COA - Clean-Out Auger	RB - Rock Bit
CS - Continuous Sampler	RC - Rock Core
CW - Clear Water	REC - Recovery
DC - Driven Casing	RQD - Rock Quality Designation
DM - Drilling Mud	RS - Rock Sounding
FA - Flight Auger	S - Soil Sounding
FT - Fish Tail	SS - 2-in. O.D. Split-Spoon Sample
HA - Hand Auger	ST - Thin-Walled Tube Sample
HSA - Hollow Stem Auger	VS - Vane Shear Test
NW - No Water Encountered	WPT - Water Pressure Test

LABORATORY TEST ABBREVIATIONS

qp - Hand Penetrometer Reading, tsf
qu - Unconfined Compressive Strength, tsf
W - Moisture Content, %
LL - Liquid Limit, %
PL - Plastic Limit, %
PI - Plasticity Index, %
SL - Shrinkage Limit, %
LOI - Loss on Ignition, %
γ _d - Dry Unit Weight, pcf
pH - Hydrogen-Ion Concentration
P ₂₀₀ - Percent Passing a No. 200 Sieve

*The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" O.D. split-spoc sampler. The sampler is driven with a 140 lb weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test



LOG OF TEST BORING

Project **Proposed Earthen Levee**
 Location **Plymouth, Indiana**
 Client **J.F. New & Associates, Inc.**
 7770 West New York Street · Indianapolis, Indiana 46214
 317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-1**
 Elevation **102.4**
 Datum **USC & GS**
 EEI Proj. No. **1-02-096**
 Sheet **1** of **1**

Proj. No. --- Station --- Weather **Sunny** Driller **C.N.**
 Struct. No. --- Offset --- Temp. **60 deg F** Inspector ---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES					
No.	Type	Rec %	N Value	Depth ft m		q _p tsf	LOI %	γ _s pcf	W %	LL %	PL %
SS-1	X	75	24		CL, LEAN CLAY, some sand, little gravel, hard to stiff, brown to brown and gray below 4', with fragments of rock and wood (fill)	>4.5		110.7	11.3		
SS-2	X	70	7	1		2.5		113.2	15.4		
SS-3	X	75	8	5		2.5		99.7	20.4		
SS-4	X	65	6	2		1.0		109.5	18.3		
SS-5	X	70	4	3	OL, ORGANIC CLAY, trace sand, medium, dark brown, with root hairs	0.50	8.4	—	41.3		
SS-6	X	65	2	10	SM, SILTY SAND, little gravel, very loose, wet, gray						
SS-7	X	80	1	4							
SS-8	X	85	5	15	ML, SANDY SILT, loose, wet, brown						
SS-9	X	90	5	5							
SS-10	X	100	5	6	ML, SILT, trace sand, loose to dense, wet, gray, with intermittent seams of lean clay near 18'						
SS-11	X	55	6	20							
SS-12	X	75	13	7							
SS-13	X	90	29	25							
				8	End of Boring at 26 ft						
				9							
				30							

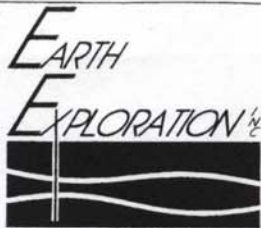
WATER LEVEL OBSERVATIONS

Depth ft ▽ While Drilling ▽ Upon Completion ▽ After Drilling
 To Water 10½ 11 BF
 To Cave-in 14

GENERAL NOTES

Start 5/22/02 End 5/22/02 Rig D120 AT
 Drilling Method 3¼" I.D. HSA
 Remarks Backfilled with auger cuttings and bentonite chip plug near surface.

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.



LOG OF TEST BORING

Project **Proposed Earthen Levee**
 Location **Plymouth, Indiana**
 Client **J.F. New & Associates, Inc.**
 7770 West New York Street · Indianapolis, Indiana 46214
 317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-2**
 Elevation **102.3**
 Datum **USC & GS**
 EEI Proj. No. **1-02-096**
 Sheet **1** of **1**

Proj. No. --- Station --- Weather **Sunny** Driller **C.N.**
 Struct. No. --- Offset --- Temp. **57 deg F** Inspector ---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES					
No.	Type	Rec %	N Value	Depth ft m		q _p tsf	LOI %	γ _d pcf	W %	LL %	PL %
SS-1	X	70	17		CL, LEAN CLAY, some sand, little gravel, hard, brown, (fill)	>4.5		122.1	11.9		
SS-2	X	75	9	1	CL, LEAN CLAY, some sand, little gravel, stiff to soft, brown to brown and gray below 6' , with trace fragments of wood (fill)	1.5		106.0	18.4		
SS-3	X	85	2	5		0.25		—	21.1		
SS-4	X	70	3	2		1.0		109.4	15.2		
SS-5	X	40	11								
	X			10	WOOD, (fill)						
SS-6	X	65	3		OL, ORGANIC CLAY, soft, dark brown		5.6	—	34.4		
SS-7	X	80	5	4	SM, SILTY SAND, trace gravel, loose, moist to wet, gray						
SS-8	X	55	3	15	ML, SILT, wet, gray						
					SP, FINE TO MEDIUM SAND, trace sand, loose, wet, gray						
SS-9	X	70	8	5	ML, SILT, trace sand, medium dense to dense, with intermittent thin seams of lean clay at 20'						
SS-10	X	90	8	6							
SS-11	X	85	9	20							
SS-12	X	100	16	7							
SS-13	X	85	38	25							
				8							
					End of Boring at 26 ft						
				9							
				30							

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	4 hrs After Drilling
To Water	13½	12	11½
To Cave-in		14½	14

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/22/02** End **5/22/02** Rig **D120 AT**
 Drilling Method **3½" I.D. HSA**
 Remarks **Backfilled with auger cuttings and bentonite chip plug near surface.**